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Merchant

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(54) **TANK ASSEMBLY HAVING TWIST-AND-LOCK MOUNTING FLANGE**

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B65D 43/02 (2006.01)

(52) **U.S. Cl.**
CPC ***B65D 43/0229*** (2013.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**
USPC 220/295, 297, 301, 787, 293; 285/209
See application file for complete search history.

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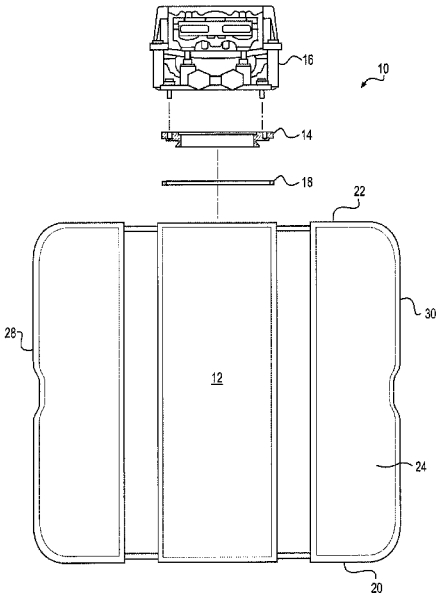
(57) **ABSTRACT**

A tank assembly is provided for a machine. The tank assembly may have a tank with a plurality of sides connected to each other to substantially enclose a volume. A first side of the plurality of sides has an upper surface and a lower surface, and defines an opening into the volume and a first rotational stop feature at the opening. The tank assembly may also have a mounting flange with an upper member configured to engage the upper surface of the first side, a lower member configured to engage the lower surface of the first side, and a second rotational stop feature. The tank assembly may additionally have a resilient member disposed between the tank and the mounting flange. The resilient member may be configured to substantially seal an interface between the tank and the mounting flange and to bias the second rotational stop feature toward the first rotational stop feature.

9 Claims, 4 Drawing Sheets



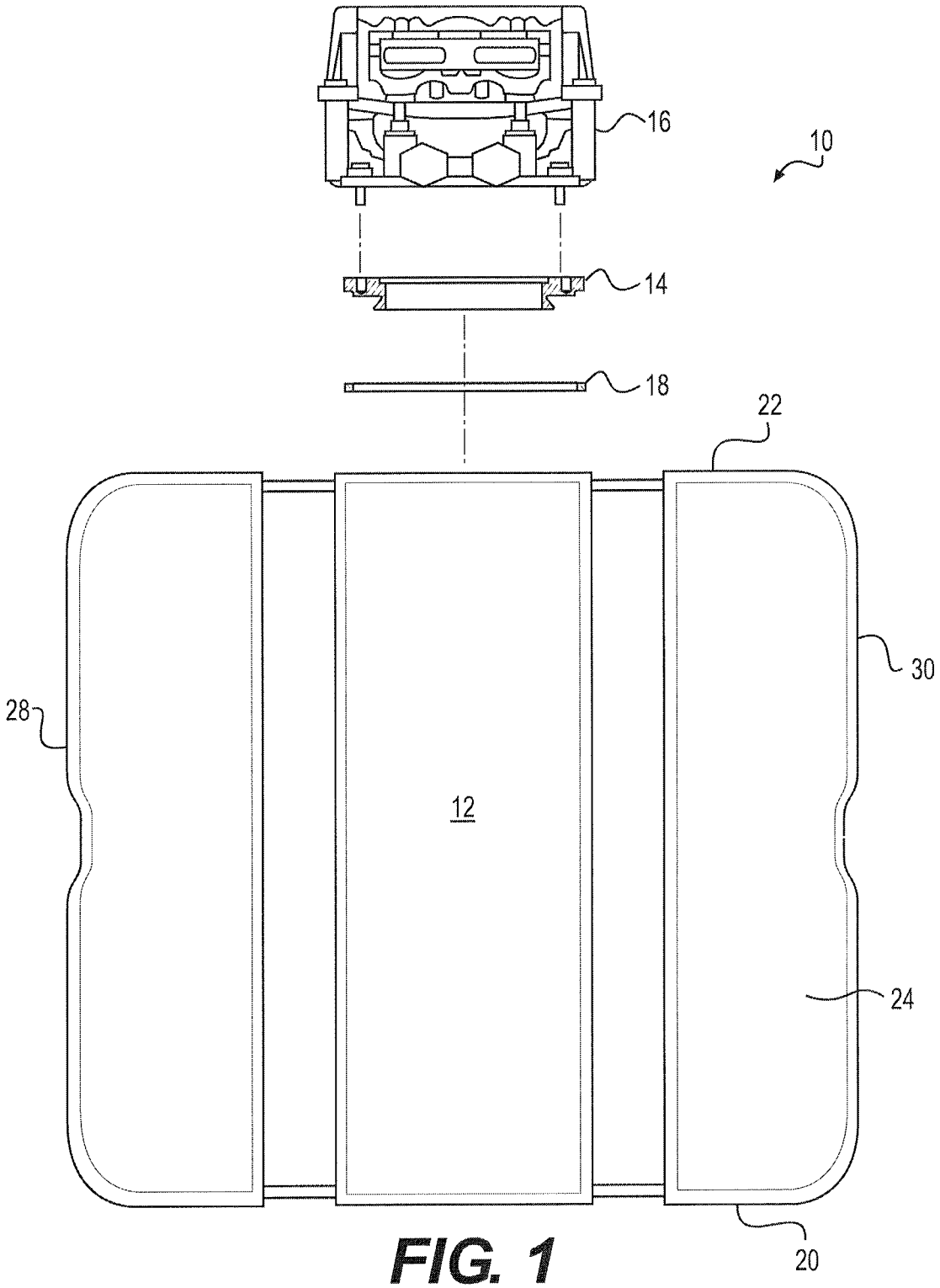


FIG. 1

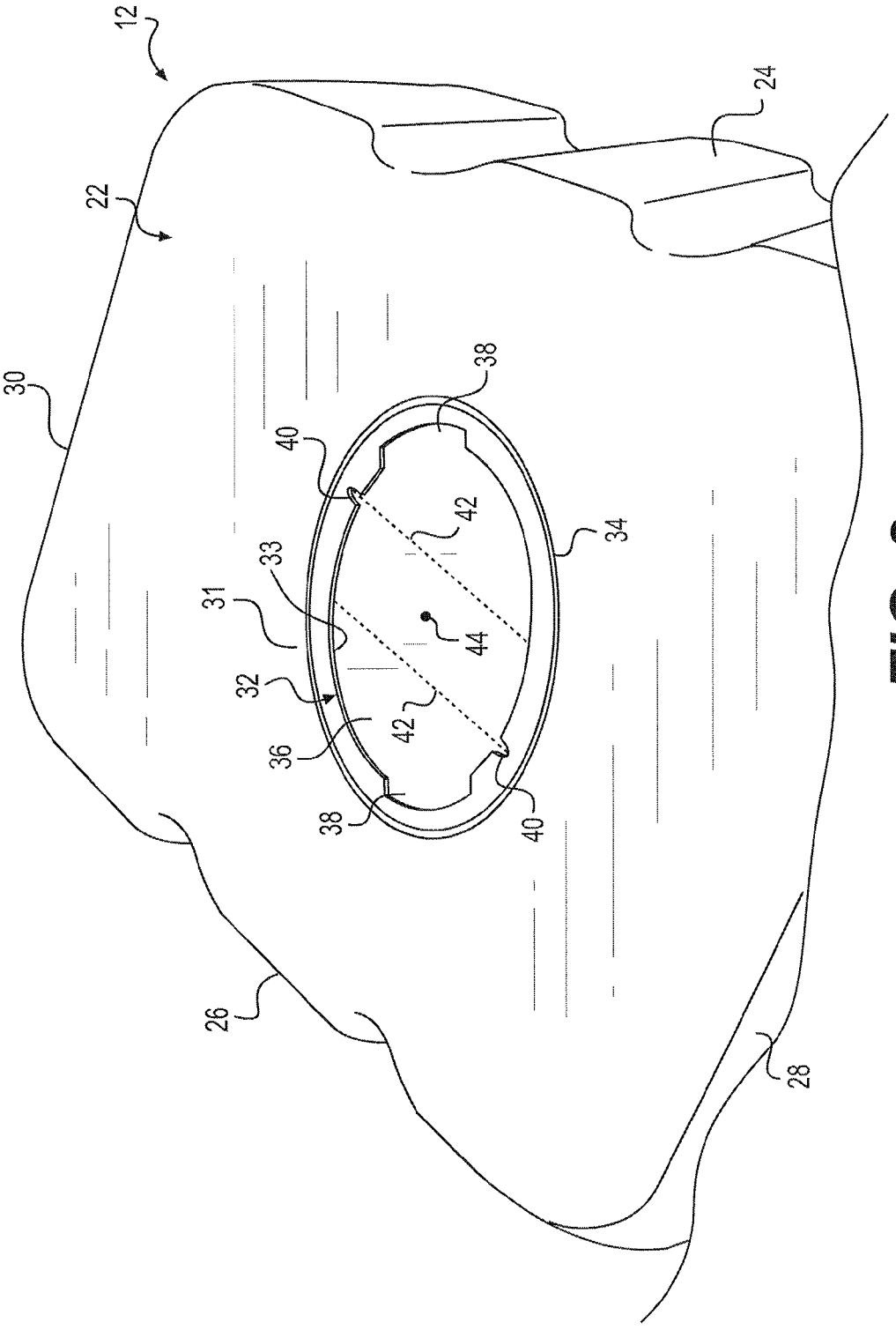


FIG. 2

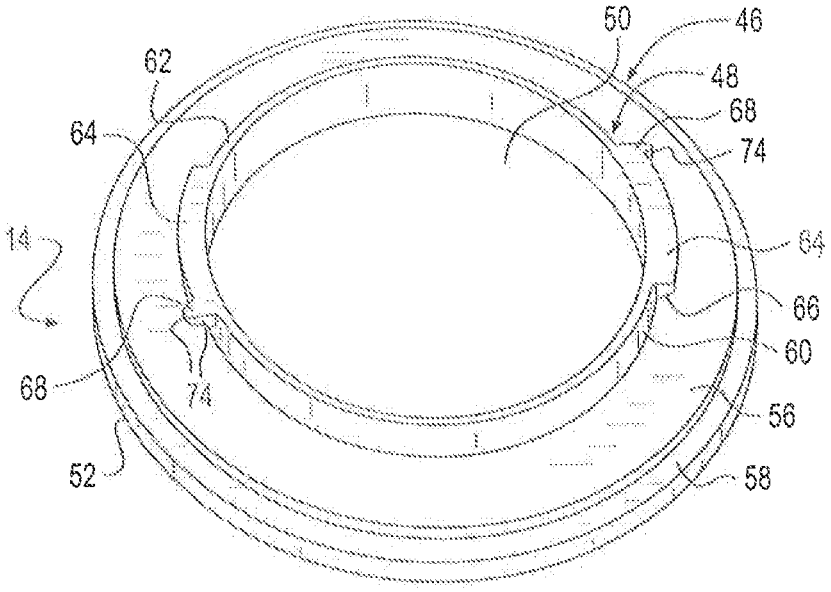


FIG. 3

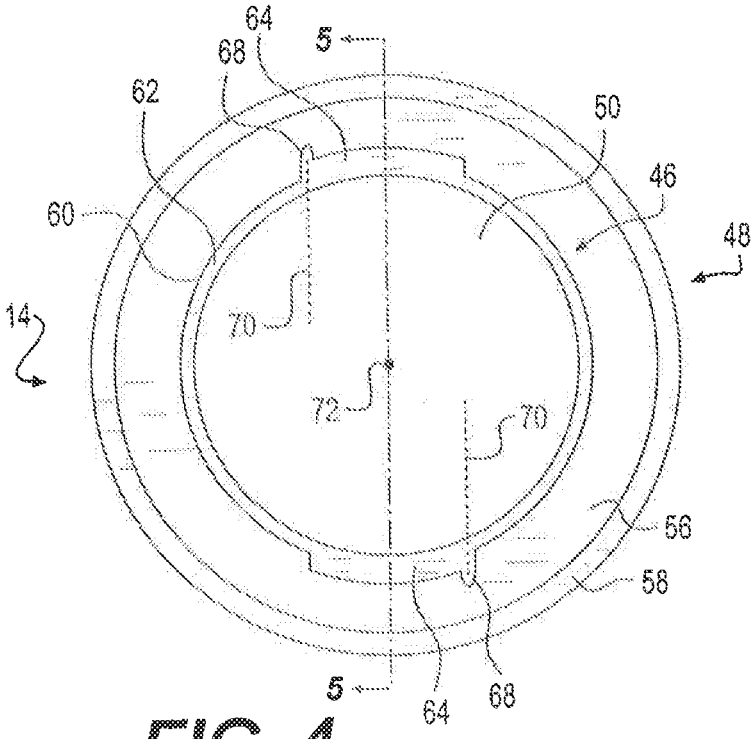


FIG. 4

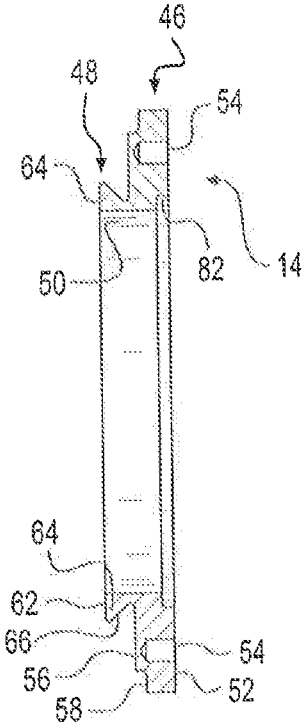


FIG. 5

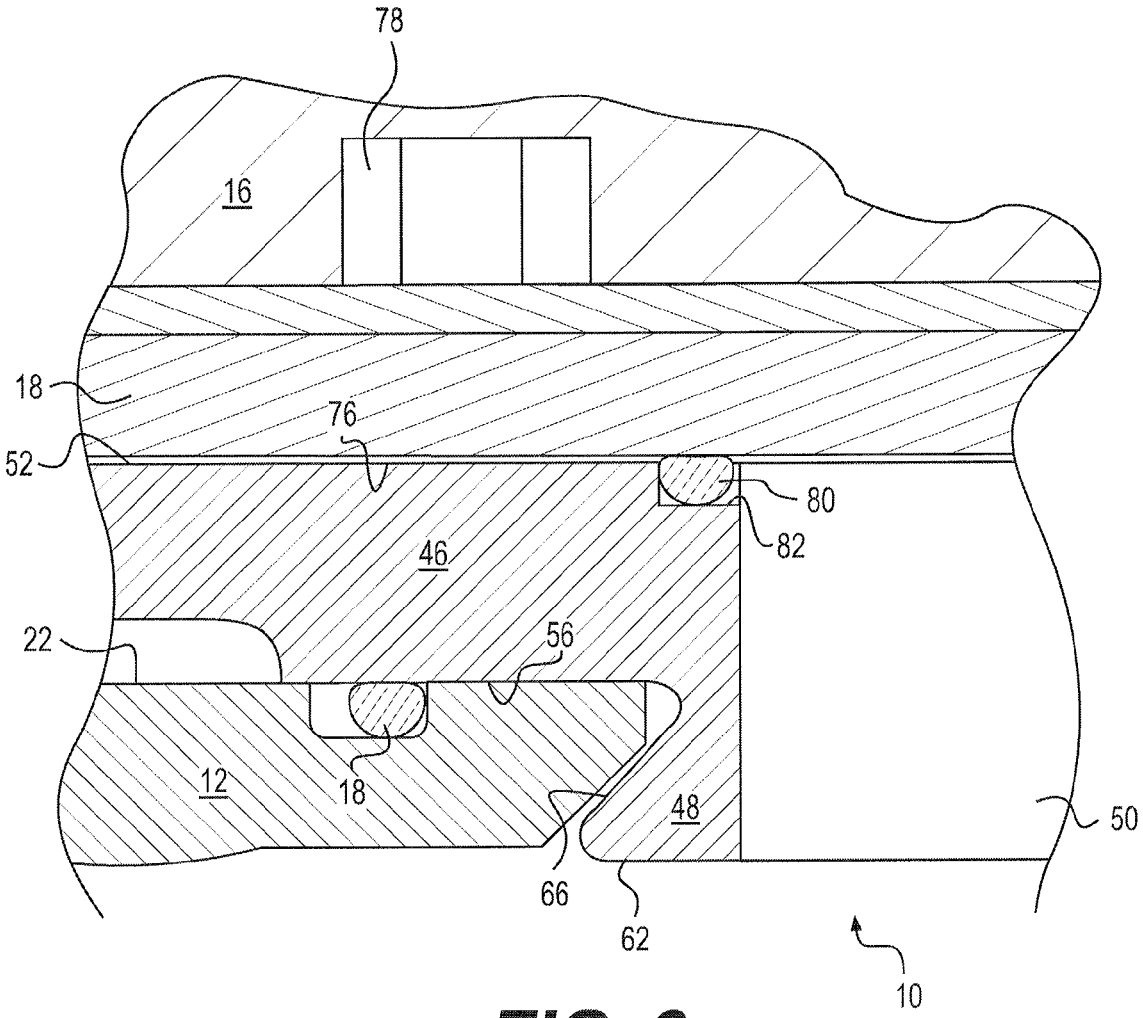


FIG. 6

TANK ASSEMBLY HAVING TWIST-AND-LOCK MOUNTING FLANGE

TECHNICAL FIELD

The present disclosure relates generally to a tank assembly and, more particularly, to a fluid tank assembly having a twist-and-lock mounting flange.

BACKGROUND

Machines such as track-type tractors, wheel loaders, on- and off-highway haul trucks, motor graders, drill rigs, stationary pumps, and other heavy equipment often use different fluid systems to accomplish specialized tasks. For example, these machines may be equipped with a fuel system that powers an onboard engine, a cooling system that cools the engine, a lubrication system that lubricates different machine components, a hydraulic system that moves a work tool, a dosing system that injects reductant into an exhaust flow to reduce emissions, and/or other fluid systems known in the art. Each of these fluid systems requires a supply of an appropriate fluid in a sealed container, which maintains the supply in relative isolation from the environment and other fluids and contaminates of the machine. In addition, the container may need to provide a mounting platform for different components associated with each fluid system, for example filters, manifolds, pumps, sensors, valves, etc.

One example of a tank assembly that contains a fluid and provides a mounting platform for related system components is described in U.S. Patent Publication No. 2010/0162690 of Hosaka et al. that was published on Jul. 1, 2010 (the '690 publication). In particular, the '690 publication discloses an urea tank providing a mounting platform for a control valve. The tank is provided with a detachable closure member having a body formed to support the control valve, and an SAE standard locking ring connected to the body. The locking ring has an annular groove recessed into the ring adjacent a perimeter of the ring, and an o-ring gasket is positioned within the groove. When the closure member is connected to the tank, the o-ring gasket is compressed to form a seal between the tank and the closure member. Protruding channels defining arcuate segments are mounted at spaced locations to an upper surface of the tank. A plurality of supports, each carrying a radially outwardly extending flange, are coupled to an upper surface of the ring. When the closure member is locked in place, the flanges are positioned within the channels of the tank. As the ring is rotated to connect the closure member to the tank, the o-ring gasket is compressed by an increasing amount to assist in applying a biasing force that holds the ring and closure member stationary relative to the tank.

Although the closure member configuration of the '690 publication may be suitable for some applications, it may be less than optimal. In particular, the configuration may require complex tank and ring geometry that is expensive to fabricate and decreases durability. Further, because the only mechanism retaining the closure member rotationally fixed is the bias from the o-ring gasket, it may be possible for the ring to rotate away from the channels and the closure member and disassemble from the tank when exposed to excessive vibration. Finally, because the closure member provides specialized mounting capability for only the control valve, it may lack broad applicability.

The disclosed tank assembly is directed to overcoming one or more of the problems set forth above and/or other problems of the prior art.

SUMMARY

In one aspect, the present disclosure is directed to a tank assembly. The tank assembly may include a tank with a plurality of sides connected to each other to substantially enclose a volume. A first side of the plurality of sides may have an upper surface and a lower surface and defines an opening into the volume and a first rotational stop feature at the opening. The tank assembly may also include a mounting flange with an upper member configured to engage the upper surface of the first side, a lower member configured to engage the lower surface of the first side, and a second rotational stop feature configured to engage the first rotational stop feature. The tank assembly may additionally include a resilient member disposed between the tank and the mounting flange. The resilient member may be configured to substantially seal an interface between the tank and the mounting flange and to bias the second rotational stop feature toward the first rotational stop feature.

In another aspect, the present disclosure is directed to a fluid tank for a tank assembly. The fluid tank may include a plurality of sides connected to each other to substantially enclose a volume, and an opening through a first side of the plurality of sides. The opening may have a generally circular center and first and second arcuate recesses located at opposing sides of the circular center. The fluid tank may also include at least one rotational stop feature located at a periphery of the opening.

In yet another aspect, the present disclosure is directed to a mounting flange for a tank assembly. The mounting flange may include a first cylindrical member having an exterior axial surface with at least one attachment feature and an interior generally planar axial surface. The mounting flange may also include a second cylindrical member extending axially from the interior generally planar axial surface of the first cylindrical member, and at least one arcuate cam segment extending radially outward from a periphery of the second cylindrical member. The mounting flange may additionally include a rotational stop feature associated with the at least one arcuate cam segment.

In a final aspect, the present disclosure is directed to a method of connecting a component to a tank. The method may include placing a resilient member between a tank and a mounting flange, and passing a member of the mounting flange through an opening in a side of the tank. The method may further include compressing the resilient member between the tank and the mounting flange, rotating the mounting flange relative to the tank until a first rotational stop feature of the tank aligns with a second stop feature of the mounting flange, and allowing the resilient member to at least partially decompress and bias the first stop feature into engagement with the second stop feature.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded-view, partial cross-sectional illustration of an exemplary disclosed tank assembly;

FIG. **2** is a pictorial illustration of an exemplary disclosed tank that may be used with the tank assembly of FIG. **1**;

FIGS. **3-5** are pictorial, plan, and cross-sectional illustrations, respectively, of an exemplary disclosed mounting flange that may be used with the tank assembly of FIG. **1**; and

FIG. **6** is an enlarged cross-sectional illustration of a portion of the tank assembly of FIG. **1**.

DETAILED DESCRIPTION

FIG. **1** illustrates a tank assembly **10** configured to contain a liquid or gaseous fluid. In the disclosed embodiment, tank

assembly **10** is intended for use with a reductant dosing system (not shown) and, accordingly, is configured to hold a reductant such as urea or a mixture of urea solids and water. It is contemplated, however, that tank assembly **10** may alternatively be used to hold another liquid or gaseous fluid, if desired, such as coolant, fuel, hydraulic oil, or lubricant. Tank assembly **10** may include, among other things, a tank **12**, a mounting flange **14** that may be used to connect a system component **16** to tank **12**, and a resilient member **18** located between tank **12** and mounting flange **14**.

Tank **12** may include a plurality of sides connected to each other to substantially enclose a volume. For example, tank **12** may include a bottom side **20** (shown only in FIG. **1**) configured to rest on a ground surface (not shown) and support a remainder of tank assembly **10**, a top side **22** located opposite bottom side **20**, a front side **24** connected between bottom and top sides **20**, **22**, a back side **26** (shown only in FIG. **2**), a left side **28** located between front and back sides **24**, **26**, and a right side **30** located opposite left side **28**. Although the sides of tank **12** are shown in FIGS. **1** and **2** as connected to each other to form a generally cubic three-dimensional structure, it is contemplated that tank **12** may alternatively form another desired shape, for example spherical, cylindrical, pyramidal, or another shape known in the art. Sides **20**-**30** may be connected together through any manner known in the art, for example through mechanical bonding (e.g., brazing, welding, etc.), chemical bonding (e.g., via adhesives), or mechanical fastening (e.g., riveting, threaded fasteners, etc.). Alternatively, sides **20**-**30** may be integrally formed into the cubic structure of tank **12** through a deep draw or molding process, if desired. Tank **12** may be fabricated from any material suitable to a particular application, for example plastic, aluminum, or stainless steel.

As shown in FIG. **2**, top side **22** may include geometry configured to connect tank **12** to mounting flange **14** (referring to FIG. **1**) and to provide access for system component **16** into the enclosed volume of tank **12**. Specifically, top side **22** of tank **12** may include an upper or outer surface **31**, a lower or inner surface **33**, an opening **32** that extends from upper surface **31** through inner surface **33**, and a groove **34** located within upper surface **31** radially outward of opening **32**. Although shown as generally located within a lengthwise and widthwise center of top side **22**, it is contemplated that opening **32** and groove **34** may be located at any appropriate position within top side **22**, for example toward one edge of tank **12** or within a corner of top side **22**, as desired.

Opening **32** may include a circular center **36** and at least one arcuate recess **38** located at a periphery of circular center **36**. In the embodiment of FIG. **2**, two substantially identical arcuate recesses **38** are shown as being located at opposing sides of circular center **36**, although any number of arcuate recesses **38** may be included. Each of arcuate recesses **38** may be concentric with and have an outer diameter greater than an outer diameter of circular center **36**, and an arc angle that is equal to or less than about 90°. The difference in diameters between circular center **36** and arcuate recesses **38** may vary based on application, and be related to a material composition of tank **12**, a thickness of top side **22**, and a retention force required for mounting flange **14** (referring to FIG. **1**). The arc angle of recesses **38** may be constrained to be equal to or less than 90°, such that sufficient material between pairs of recesses **38** may be retained to support mounting flange **14**.

One or more rotational stop features **40** may be provided within top side **22** at opening **32**. In the disclosed embodiment, rotational stop features **40** are integral with opening **32**, although it is contemplated that rotational stop features **40** may alternatively be completely separate from opening **32**, if desired. As shown in FIG. **2**, rotational stop features **40** may be radially-oriented recesses that extend outward from a periphery of circular center **36**. Each of rotational stop features **40** may be elongated and have a length direction greater than a width direction, and a plane of symmetry (not shown) that is generally orthogonal to top side **22** and extends in the length direction along a dashed line **42**. In the disclosed embodiment, the planes of symmetry of rotational stop features **40** may be generally parallel to each other, and tangential relative to an axis **44** of circular center **36** (i.e., not passing through axis **44**). Rotational stop features **40** may be located in a clockwise direction from an arc end of the furthest arcuate recess **38** by about 90°. As will be described in more detail below, this geometry of rotational stop features **40** may facilitate reduced complexity and cost associated with manufacturing mounting flange **14** (referring to FIG. **1**), while providing for a ¼ turn locking engagement between tank **12** and mounting flange **14**.

Groove **34** may be located within upper surface **31** of top side **22** and configured to receive resilient member **18** (referring to FIG. **1**). Groove **34** may have a generally square cross-section (shown in FIG. **6**), a generally semi-circular cross-section (not shown), or any other cross-section known in the art. A depth of groove **34** may be less than a thickness (e.g., a diameter) of resilient member **18** such that, when mounting flange **14** is pressed against upper surface **31** of top side **22**, resilient member **18** may be compressed by some amount. It is contemplated that groove **34** may alternatively be located within mounting flange **14** or partially within both tank **12** and mounting flange **14**, if desired.

As shown in FIGS. **3**-**5**, mounting flange **14** may include a generally cylindrical upper member **46**, a generally cylindrical lower member **48**, and a central bore **50** passing through upper and lower members **46**, **48**. Upper member **46** may be configured to provide a mounting platform for system component **16** (referring to FIG. **1**) and generally remain engaged with upper surface **31** of top side **22** (referring to FIG. **2**) after assembly. Lower member **48** may be configured to engage lower surface **33** of top side **22**, thereby retaining mounting flange **14** connected to tank **12**, as will be described in more detail below. Central bore **50** may provide a fluid path for the contents of tank **12** through upper and lower members **46**, **48**.

Upper member **46** may have an outer diameter greater than the outer diameter of lower member **48** and opening **32** (referring to FIG. **2**), and include an axially exterior surface **52** that is generally planar and at least one mounting feature **54** (shown only in FIG. **5**) at surface **52** that is configured to retain system component **16** (referring to FIG. **1**). In the disclosed embodiment, mounting feature **54** may be a threaded bore configured to receive fasteners of system component **16**. It is contemplated, however, that mounting feature **54** may embody another type of mounting feature known in the art, if desired, such as a threaded stud, an interlocking tab, or another feature. Upper member **46** may also include an axially interior surface **56** that is generally planar and configured to engage resilient member **18** at top side **22**. In some embodiments, interior surface **56** may include a stepped shoulder **58** at a periphery thereof, if desired. In these embodiments, stepped shoulder **58** may facilitate a grinding/polishing fabrication procedure.

Lower member **48** may extend axially from interior surface **56** and include an annular side surface **60** and an axially exterior surface **62**. An outer diameter of annular side surface **60** may be less than an outer diameter of circular center **36** of opening **32** (referring to FIG. **2**) such that lower member **48** may pass through opening **32** during assembly. Lower member **48** may also include, at a distal end, at least one arcuate

cam segment **64** that extends radially outward from annular side surface **60** (i.e., radially outward from a periphery of lower member **48**) at the distal end.

In the disclosed embodiment, lower member **48** includes two substantially identical arcuate cam segments **64** that are located at opposing sides of lower member **48**, although any number of arcuate cam segments **64** may be included. Arcuate cam segments **64** may have an outer diameter greater than an outer diameter of annular side surface **60** and circular center **36** (referring to FIG. **2**), but less than an outer diameter of arcuate recesses **38** and upper member **46**, and an arc angle that is equal to or less than about 90°. The difference in diameters between arcuate cam segments **64** and circular center **36** and arcuate recesses **38** may facilitate passage of lower member **48** into tank **12** via opening **32** and, after rotation of mounting flange **14**, the engagement between arcuate cam segments **64** and lower surface **33** of top side **22** that retains mounting flange **14** connected to tank **12**.

Arcuate cam segments **64** may have an axially exterior surface that is generally co-planar with exterior surface **62**, and an axially interior surface **66** that is inclined relative to an axis of central bore **50**. The inclination angle of interior surface **66** may be substantially constant or, alternatively vary (e.g., decrease) along an arc length of segments **64**. The inclination angle of interior surface **66**, together with the generally planar interior surface of upper member **46**, may create a space therebetween that has a greater axial dimension at an outer diameter of lower member **48** than at an inner diameter thereof. The exterior surface of arcuate cam segments **64** may merge with interior surface **66** at an outer diameter of arcuate cam segments **64**. As will be described in more detail below, when assembled, interior surface **66** may engage lower surface **33** of top side **22** (referring to FIG. **2**). In some embodiments, lower surface **33** may include an internal chamfer (shown in FIG. **6**) at the engagement with interior surface **66** that matches the inclination of interior surface **66**. The matching angular surfaces may help to improve engagement between the two components.

Lower member **48** may also include at least one rotational stop feature **68** at an arc end of one or both of arcuate cam segments **64**. In the disclosed embodiment, one rotational stop feature **68** is integral with each arcuate cam segments **64** and located at a counter-clockwise arc end (when viewed from the lower-member end of mounting flange **14** as shown in FIGS. **3** and **4**) of the corresponding cam segment **64**. It is contemplated, however, that rotational stop features **68** may be completely separate from arcuate cam segments **64** and located at another angular location around annular side surface **60**, if desired.

As shown in FIG. **4**, rotational stop features **68** may be radially-oriented protrusions that extend outward from annular surface **60** at the arc end of cam segments **64**. Each of rotational stop features **68** may be generally elongated, and have a length direction greater than a width direction and a plane of symmetry (not shown) that is generally orthogonal to exterior surface **62** and extends in the length direction along a dashed line **70**. In the disclosed embodiment, the planes of symmetry of rotational stop features **68** may be generally parallel to each other and tangential relative to an axis **72** of central bore **50** (i.e., not passing through axis **72**). In addition, rotational stop features **68** may have an axial exterior surface that is generally co-planar with exterior surface **62**, and inclined interior surfaces **74** that extend from exterior surface **62** inward toward interior surface **56** of upper member **46** and meet at a lengthwise knife-edge to form a general wedge shaped cross-section. When mounting flange **14** is fully assembled to tank **12**, the knife-edges of rotational stop features **68** may be urged into the recesses of rotational stop features **40**, thereby inhibiting rotation of mounting flange **14** relative to tank **12**.

The geometry of rotational stop features **68** may facilitate reduced complexity and cost associated with manufacturing mounting flange **14**. In particular, the angular orientation (i.e., being tangentially oriented) and inclined surfaces (i.e., the wedge shaped cross-section) of rotation stop features **68** may allow for mounting flange **14** to be produced through a simple low-cost casting process that utilizes a multi-piece (e.g., a two-piece) mold.

Resilient member **18** may be a compressible gasket, for example a polymeric o-ring, that performs multiple functions for tank assembly **10**. First, resilient member **18** may create a substantially fluid-tight seal between tank **12** and mounting flange **14** by deforming when compressed (as shown in FIG. **6**) to fill voids that might exist at the interface. Second, resilient member **18**, because of its resiliency, may function as a spring when compressed to urge upper member **46** of mounting flange **14** away from tank **12** and rotational stop feature **68** into rotational stop feature **40**, thereby inhibiting rotation of mounting member **14** (i.e., inhibiting the rotation of cam segments **64** toward arcuate recesses **38**) to a point of disengagement.

System component **16** may be any type of component known in the art that requires or benefits from connection to tank **12**. For example, system component **16** may be a filter, a manifold, a pump (shown in FIG. **1**), a sensor, a valve, or another similar component or combination of components. As shown in FIG. **6**, system component **16** may including a mounting surface **76** configured to engage exterior surface **52** of upper member **46**, and one or more mounting features **78** (e.g., threaded fasteners) configured to engage mounting features **54** (referring to FIG. **5**) of mounting flange **14**. In one embodiment, a seal **80**, for example an o-ring, may be positioned between system component **16** and mounting flange **14**, if desired. In this embodiment, mounting flange **14** may be provided with geometry **82** (e.g., a shoulder or groove) configured to receive seal **80**. Alternatively or additionally, mounting surface **76** of system component **16** may be provided with seal-receiving geometry, if desired.

Industrial Applicability

The disclosed tank assembly may be applicable to any machine fluid system where containment and isolation of a specific fluid is desired. The disclosed tank assembly may be particularly applicable to applications where other system components require direct mounting on the tank assembly. The disclosed tank assembly may provide for direct mounting of system components via a mounting configuration that is simple and inexpensive to fabricate, as well as durable under extreme conditions. Assembly of tank assembly **10** will now be described.

To construct tank assembly **10**, resilient member **18** may first be placed within groove **34** at top side **22** of tank **12**. Mounting flange **14** must then be oriented so that arcuate cam segments **64** generally align with arcuate recesses **38** in top side **22** of tank **12**, and then be passed through opening **32** into tank **12** until interior surface **56** of upper member **46** engages resilient member **18**. At this point in time, lower member **48** may be at least partially within the enclosed volume of tank **12**. Mounting flange **14** may then be pushed further toward tank **12** and against resilient member **18**, until resilient member **18** compresses sufficiently for rotational stop feature **68** to clear lower surface **33** of top side **22**. Mounting flange **14** may now be free to rotate relative to tank **12**.

Mounting flange **14** may be twisted during assembly until rotational stop features **68** generally align with rotational stop

features **40** in tank **12**. In the illustrated embodiment, this rotation may be about equal to a ¼ turn (i.e., a 90° turn) in the clockwise direction, although it is contemplated that mounting flange **14** may alternatively be rotated by a different amount and/or in the counter-clockwise direction during assembly, if desired. When rotational stop feature **68** is generally aligned with rotational stop feature **40**, resilient member **18** may be allowed to now at least partially decompress and bias the wedge shape of rotational stop features **68** upward into engagement with rotational stop features **40**, thereby rotationally locking mounting flange **14** to tank **12**. At this point in time, resilient member **18** may still be compressed somewhat to provide a substantially fluid-tight seal between mounting flange **14** and tank **12**. Mounting flange **14** may only be disassembled from tank **12** via recompression of resilient member **18** and reverse rotation (e.g., counter-clockwise rotation) of mounting flange **14** relative to tank **12**. System component **16** may be connected to mounting flange **14** via seal **80** and fasteners **78** before or after mounting flange **14** is locked to tank **12**.

The disclosed tank assembly may be simple and inexpensive. In particular, because no hardware may be required to connect mounting flange **14** to tank **12**, the manufacture cost and complexity of both components may be low. In addition, the geometry of the features (arcuate cam segments **64** and rotational stop features **40**, **68**) that lock mounting flange **14** to tank **12** may be few in number and relatively simple. Further, the design of mounting flange **14** may be generic and allow a variety of different system components to be mounted to tank **12**, thereby decreasing a cost of tank assembly **10** while also increasing an applicability of tank assembly **10**.

The disclosed tank assembly may also be durable. In particular, after mounting flange **14** is connected to tank **12**, disassembly may be inhibited via rotational stop features **40** and **68**. That is, mounting flange **14** may only be disassembled from tank **12** by recompression of resilient member **18** and subsequent rotation of mounting flange **14** relative to tank **12**. This resistance to disassembly may allow the use of tank assembly **10** in extreme conditions, such as high-vibration conditions where other types of assemblies may be unreliable.

It will be apparent to those skilled in the art that various modifications and variations can be made to the tank assembly of the present disclosure. Other embodiments of the tank assembly will be apparent to those skilled in the art from consideration of the specification and practice disclosed herein. For example, although not shown in the associated figures, it is contemplated that tank assembly **10** may include addition features, if desired, such as a fill spout, a carrying handle, a drain valve, a fluid level sensor, internal baffles, and other similar features. It is intended that the specification and examples be considered as exemplary only, with a true scope of the disclosure being indicated by the following claims and their equivalents.

What is claimed is:

1. A tank assembly, comprising:

a tank enclosing a volume and having a sidewall with an upper surface and a lower surface and defining an opening into the volume and a first rotational stop feature at the opening, wherein the opening into the tank includes a generally circular center and at least one arcuate recess located at a periphery of the generally circular center, and the first rotational stop feature includes at least one recess in the sidewall of the tank;

a mounting flange having an upper member configured to engage the upper surface of the sidewall, a lower member configured to engage the lower surface of the sidewall, and a second rotational stop feature configured to engage the first rotational stop feature, wherein the lower member includes at least one arcuate cam segment extending radially outward, the at least one arcuate cam segment configured to pass through the at least one arcuate recess during assembly, and the second rotational stop feature includes at least one protrusion extending from the lower member of the mounting flange radially outward a greater distance than a radially outermost surface of the at least one arcuate cam segment; and

a resilient member disposed between the tank and the mounting flange, the resilient member configured to substantially seal an interface between the tank and the mounting flange and to bias the second rotational stop feature into engagement with the first rotational stop feature upon at least partial decompression of the resilient member when the mounting flange is locked to the tank.

2. The tank assembly of claim **1**, wherein:

the first rotational stop feature is located in a clockwise direction spaced from an arc end of the at least one arcuate recess; and

the second rotational stop feature is located at an arc end of the at least one arcuate cam segment.

3. The tank assembly of claim **1**, wherein an outer diameter of the at least one arcuate cam segment is greater than a diameter of the generally circular center of the opening into the tank and less than an outer diameter of the at least one arcuate recess.

4. The tank assembly of claim **1**, wherein the at least one protrusion extends radially outward a greater distance than a remaining portion of the lower member, and includes a generally planar exterior surface and a wedge-shaped interior surface configured to engage the at least one recess of the first rotational stop feature.

5. The tank assembly of claim **1**, wherein:

the at least one recess includes two recesses located at opposing sides of the opening; and

the at least one protrusion includes two protrusions located at opposing sides of the lower member.

6. The tank of claim **5**, wherein:

each of the two protrusions has a center plane of symmetry that is generally parallel with the center plane of symmetry of the other of the two protrusions; and

each center plane of symmetry is radially offset from an axis of the lower member.

7. The tank assembly of claim **1**, wherein:

one of the upper member and the upper surface of the sidewall of the tank includes a generally planar axial sealing surface; and

the other of the upper member and the upper surface includes an annular groove configured to receive the resilient member.

8. The tank assembly of claim **1**, wherein:

the upper member includes an axially exterior surface and an axially interior surface located opposite the axially exterior surface; and

the mounting flange further includes at least one mounting feature at the axially exterior surface that is configured to provide mounting for a fluid system component.

9. The tank assembly of claim **8**, wherein the mounting flange further includes a central bore passing through the upper and lower members.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,102,445 B2
APPLICATION NO. : 13/095618
DATED : August 11, 2015
INVENTOR(S) : Merchant

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims

Column 8, line 43, claim 6, delete "The tank of claim 5," and insert -- The tank assembly of claim 5, --.

Signed and Sealed this
Twenty-fifth Day of October, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office